

## Reply to "Is command following unrelated to top-down attention in consciousness disorders?"

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## **Reply to “Is command following unrelated to top-down attention in consciousness disorders?”**

We recently reported a correspondence between event-related potential (ERP)-based evidence of bottom-up attention and command following among patients with severe brain injury<sup>1</sup>. The P3a ERP reflects bottom-up attention and is often obtained by comparing responses to non-target deviant and standard stimuli<sup>2</sup>. The P3b ERP reflects top-down attention and is often obtained by comparing responses to target deviant and standard stimuli<sup>2</sup>. In our article<sup>1</sup>, we quantified bottom-up attention by comparing responses to all deviant stimuli – target and non-target – and all standard stimuli. In their letter<sup>3</sup>, Bonfiglio and Carboncini highlight that our ERP definition comprises both P3a and P3b components and postulate that top-down attention may underlie our reported relationship between command following and ERP-based evidence of attention.

Our contrasts delineate a hierarchy of cognitive abilities. We quantified bottom-up attention by comparing all deviant and standard trials. This contrast has more statistical power than the conventional P3a contrast because more deviant trials are available. Furthermore, we quantified top-down attention by directly comparing target and non-target deviant trials. This approach was necessary because a deviant stimulus is only a target in our paradigm if the participant selectively attends to that deviant stimulus when instructed. If the participant does not comply with task instructions, however, the conventional P3b contrast (target versus standard) could return a significant effect driven by attentional orienting to deviant stimulation. This concern is particularly relevant for the patients in our investigation who could not overtly confirm that they understood and followed task instructions.

To examine any differences between the two approaches, we conducted the P3a and P3b comparisons described by Bonfiglio and Carboncini<sup>3</sup>. These comparisons yielded findings consistent with our original report<sup>1</sup>: we detected P3a effects from all healthy volunteers and all patients who demonstrated command following; and we did not detect P3b effects from any of the patients. The conventional P3b contrast yielded a higher hit-rate in our healthy volunteers (100%) than our original approach (67%); this likely owes to the greater depth of processing elicited by targets relative to standards, as compared with targets relative to non-targets. However, as explained above, the conventional P3b contrast does not necessarily isolate top-down attention in our paradigm.

Bonfiglio and Carboncini<sup>3</sup> also propose an explanatory role of cognitive attitudes in command following, which could be quantified using blink-related EEG<sup>4,5</sup> or fMRI-based activation of particular cortical networks. We cannot directly investigate this proposal because our EEG and fMRI data were not collected simultaneously. However, the evidence linking intrinsic networks to external awareness adds weight to their hypothesis<sup>6</sup>.

### **Author Contributions**

All authors contributed equally to this work.

### **Potential Conflicts of Interest**

Nothing to report.

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